REMARKS

I. INTRODUCTION

In response to the Office Action dated October 14, 2005, and in conjunction with the request for continued examination (RCE) submitted herewith, claim 1 has been amended and new claim 27 has been added. Claims 1-3 and 5-27 are in the application. Re-examination and re-consideration of the application, as amended, is requested.

II. NON-ART REJECTIONS

On page (2) of the Office Action, claims 1-3 and 5-8 were rejected under 35 U.S.C. §112, first paragraph, as failing to comply with the written description requirement. According to the Office Action, the claims contain subject matter which was not described in the specification, allegedly because the limitation "the electro-absorption modulator does not include quantum wells" is not disclosed in the specification.

Applicants' attorney respectfully traverses the rejections in light of the amendments to the specification made above and the arguments below.

As noted in the specification, in the paragraph at page 6, line 30, the operation of the modulator 20 is based on <u>either</u> (1) the Franz-Keldysh effect in a bulk semiconductor waveguide 22 <u>or</u> (2) the quantum confined Stark effect in a MQW. Someone of ordinary skill in the art would understand this statement to mean that, when the modulator 20 uses Franz-Keldysh effects in a bulk semiconductor waveguide, the modulator 20 does <u>not</u> include quantum wells.

Consequently, the amendments to the specification made above do not introduce new matter. Further, these amendments overcome the rejections under 35 U.S.C. §112, first paragraph.

III. PRIOR ART REJECTIONS

A. <u>The Office Action Rejections</u>

On pages (2) and (3) of the Office Action, claims 1 and 7 were rejected under 35 U.S.C. §102(b) as being anticipated by Kinoshita, U.S. Patent No. 5,883,914. On page (4) of the Office Action, claims 2, 3, and 8 were rejected under 35 U.S.C. §103(a) as being unpatentable in view of the combination of Kinoshita and Coldren, U.S. Patent No. 4,896,325. On pages (4) and (5) of the Office Action, claim 5 was rejected under 35 U.S.C. §103(a) as being unpatentable in view

of the combination of Kinoshita and Berger et al. (Berger), U.S. Patent No. 5,208,821. On page (5) of the Office Action, claim 6 was rejected under 35 U.S.C. §103(a) as being unpatentable in view of the combination of Kinoshita and Yap, U.S. Patent No. 5,138,626.

Applicants' attorney respectfully traverses the rejections.

B. Applicants' Independent Claim

Independent claim 1 is directed to a tunable laser source comprising

a widely tunable semiconductor laser comprised of an active region including multiple quantum wells (MQWs) grown on top of a thick, low bandgap, single common waveguide layer, wherein both the waveguide layer and the active region are fabricated between a p-doped region and an n-doped region; and

an electro-absorption modulator integrated into the semiconductor laser, wherein the electro-absorption modulator (EAM) does not include quantum wells (QWs) and instead uses Franz-Keldysh effects for modulation, the electro-absorption modulator shares the waveguide layer with the semiconductor laser, and the waveguide layer is designed to provide high index tuning efficiency in the laser and good reverse bias extinction in the modulator.

C. The Kinoshita Reference

Kinoshita describes a grating coupled laser (GCL) that is formed on a first major surface of a semi-insulating InP substrate. Specifically, an InGaAsP active layer, an InGaAsP waveguide path and a striped grating having two phase shift portions are formed on the first major surface of the InP substrate. An EA modulator is formed on a second major surface of the semi-insulating InP substrate. Specifically, a p-InP layer, an MQW structure of 100-layer, an n.sup.- -InP layer and an n.sup.+ -InP layer are formed on the second major surface of the InP substrate. The first major surface and second major surface of the InP substrate are inclined to each other by a few degrees.

D. The Coldren Reference

Coldren describes an improvement for allowing selective tuning of the emitted beam over a broad bandwidth to a diode laser having an active section for creating a light beam by spontaneous emission over a bandwidth around some center frequency and for guiding and

reflecting the light beam between a pair of mirrors bounding the active on respective ends thereof to create an emitted beam of laser light. The mirrors each have narrow, spaced reflective maxima with the spacing of the reflective maxima of respective ones of the mirrors being different whereby only one the reflective maxima of each of the mirrors can be in correspondence and thereby provide a low loss window at any time. The preferred mirrors each include a plurality of discontinuities to cause the narrow, spaced reflective maxima wherein the spacing of the discontinuities of one mirror is different from the spacing of the discontinuities of the other mirror so as to cause the wavelength spacing of the maxima to be different. Additionally, the preferred embodiment includes a vernier circuit operably connected to the mirrors for providing an electrical signal to the mirrors which will cause continuous tuning within a desired frequency band, an offset control circuit operably connected to the mirrors for providing a voltage signal to the mirrors which will shift the reflective maxima of the mirrors into alignment at a desired frequency mode, and a phase control circuit for adjusting the laser mode wavelength to be in correspondence with the low loss window.

E. <u>The Berger Reference</u>

Berger describes an invention that pertains to buried heterostructure lasers which have been fabricated using a single step MOCVD growth of an MQW laser structure over a pattern etched GaAs substrate. The wet chemical etching of grooves having a dovetailed cross-section and being parallel to the [011] direction in GaAs substrates produced reentrant mesas which resulted in isolated laser active regions buried by the AlGaAs cladding layer. The 250 .mu.m long uncoated lasers emit at about 1 .mu.m. Lasers with coated facets have threshold currents of 20 mA and emit >100 mW per facet under room temperature operation. The external differential quantum efficiency for currents of from 30 mA to about 50 mA is found to be nearly independent of temperature in the range of 10.degree. C. to 90.degree. C. suggesting a low temperature dependence of leakage current.

F. <u>The Yap Reference</u>

Yap describes a laser structure that achieves high reliability, good bandwidth and performance characteristics and a fabrication procedure that is compatible with other IC devices by providing an active lasing region below an optical mode confining ridge. The active region is

preferably a multiple quantum well (MQW) that is sandwiched between upper and lower cladding layers. The portions of the MQW lateral to the ridge are compositionally disordered to give them a larger bandgap energy and lower refractive index than the active MQW region, and thus resist charge carrier spreading from the MQW. The ridge provides the primary optical mode confinement, allowing a shallow burial of the MQW to a depth less than 0.5 microns. This permits the compositional disordering of the lateral MQW regions to be performed by a heated ion implantation process that requires a lower temperature than separate implantation and annealing, and is compatible with the provision of additional circuitry on the same substrate.

G. The Applicants' Invention is Patentable Over the References

Applicants' attorney respectfully submits that the claims are patentable over the references. Specifically, Applicants' claims recite limitations not shown in the references, taken individually or in combination.

On the other hand, the Office Action asserts that Kinoshita teaches all the elements of Applicants' claim 1 at col. 3, lines 12-21. A more complete portion of Kinoshita, including the Office Action citation, is set forth below:

> Kinoshita: Col. 2, line 45 – col. 3, line 26
>
> FIG. 1 shows a device disclosed in Document 1 (K. Wakita, et al., IEEE Photonics Technology Letter, vol. 5, No. 8, p. 899, 1993).
>
> In this device, a DFB laser and an EA modulator are integrated monolithically. The DFB laser and EA modulator are connected coaxially and a laser beam from the DFB laser is emitted in parallel to the surface of the substrate via the modulator.
>
> FIG. 2 shows a device disclosed in Document 2 (I. Kotani, et al., IEEE Photonics Technology Letter, vol. 5, No. 1, p. 62, 1993).
>
> In this device, too, a DFB laser and an EA modulator are integrated monolithically. Like the device shown in FIG. 1, the DFB laser and EA modulator are connected coaxially and a laser beam from the DFB laser is emitted in parallel to the surface of the semiconductor substrate via the modulator.
>
> FIGS. 3A to 3E show a device disclosed in Document 3 (M. Aoki, et al., Electronics Letters, vol. 27, No. 23, p. 621, 2138, 1991).
>
> In this device, too, a DFB laser and an EA modulator are integrated monolithically. Like the device shown in FIG. 1, the DFB laser and EA modulator are connected coaxially and a laser beam from the DFB laser is emitted in parallel to the surface of the semiconductor substrate via the modulator.
>
> FIG. 4 shows a device disclosed in Document 4 (U. Koren, et al., Electronics Letters, vol. 23, No. 12, p. 621, 1987).

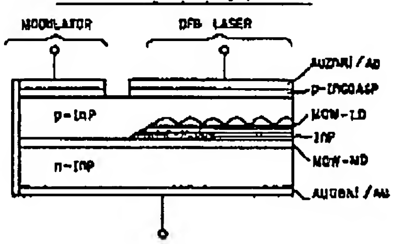
This device is a discrete semiconductor device in which an EA modulator is formed monolithically.

The devices of Documents 1 to 3 are characterized in that the DFB laser and EA modulator are integrated coaxially in the direction of the waveguide.

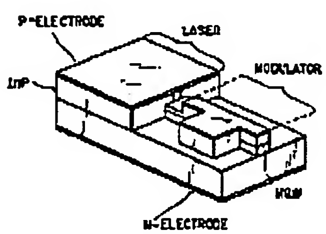
The DFB laser having an active layer of an MQW (Multi-Quantum Well) structure has a driving electrode, to which a DC current is supplied to emit an output beam. The output beam is guided as a waveguide-mode beam to a waveguide in a modulation region. **In the modulation region, only a layer necessary for guiding waves is formed, and an active layer and a grating are not provided.**

If a reverse bias voltage is applied to the modulation region, a field effect, e.g. Stark effect or Franz-Keldysh effect, occurs, and an absorption band of the waveguide is shifted to the longer wavelength side. As a result, the output light of the modulator is greatly attenuated, which implies the modulation by applying voltage. In addition, a very high speed operation higher than 10 Gbps is theoretically enabled, with extremely small chirp. (Emphasis added.)

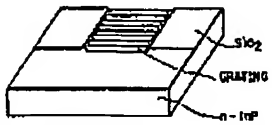
Kinoshita: FIGS. 1-3



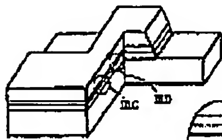
F I G. 1 PRIOR ART



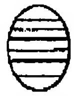
F I G. 2 PRIOR ART



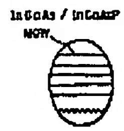
F I G. 3A PRIOR ART



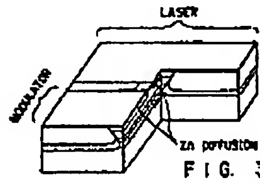
F I G. 3B
PRIOR ART



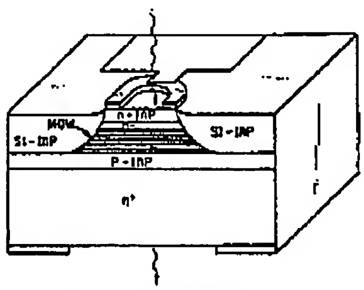
F I G. 3C
PRIOR ART



F I G. 3D
PRIOR ART



F I G. 3E PRIOR ART



F I G. 4 PRIOR ART

The prior art devices discussed in Kinoshita all appear to show MQW modulators. Kinoshita merely states that, in the modulation region, only a layer necessary for guiding waves is formed, and an active layer and a grating are not provided. However, this refers only to the absence of an active (i.e., gain) layer in the modulator. Nonetheless, the modulator waveguide of these prior art devices all appear to include MQWs.

Note also that the prior art devices discussed in Kinoshita do not include widely-tunable lasers. Instead, these prior art devices use MQWs in the modulator for enhanced efficiency, and MQW modulators do not operate over a sufficient optical wavelength range for use with widely-tunable lasers. Applicants' invention, on the other hand, uses "bulk" homogeneous waveguide material in the modulator (and throughout) to operate over a wide tuning range. As noted in

Applicants' specification, the modulator could comprise MQWs, but only for narrow ranges of operation.

Coldren, Berger and Yap fail to overcome the deficiencies of Kinoshita. Recall that Coldren was cited only against dependent claims 2-3 and 8, and then only for the structure of the laser; Berger was cited only against dependent claim 5, and then only for the structure of the waveguide as a buried heterostructure that includes MQWs; and Yap was cited only against dependent claim 6, and then only for the structure of the waveguide as a ridge waveguide that includes MQWs.

In addition, Berger also requires a complex growth process over a patterned substrate, while Applicants' device results from a simple planar growth and therefore is more manufacturable. Berger's QCSE (QW) modulators are desirable in fixed or narrowly-tunable sources, and are not useful for widely-tunable sources, because the effect is limited to a more narrow wavelength region.

Further, Yap shows the use of compositioned disordering to change the bandgap lateral to a ridge waveguide. This does not suggest an offset QW gain region. Instead, Yap is focused on centered QWs within the waveguide that must be modified to change the bandgap.

Thus, the references, taken individually or in combination, do not teach or suggest Applicants' claimed invention. Moreover, the various elements of Applicants' claimed invention together provide operational advantages over the references. In addition, Applicants' claimed invention solves problems not recognized by the references.

Consequently, Applicants' attorney submits that independent claim 1 is allowable over the references. Further, dependent claims 2-8 are submitted to be allowable over the references in the same manner, because they are dependent on independent claim 1, and thus contain all the limitations of the independent claim. In addition, dependent claims 2-8 recite additional novel elements not shown by the references.

IV. CONCLUSION

In view of the above, it is submitted that this application is now in good order for allowance and such allowance is respectfully solicited.

Should the Examiner believe minor matters still remain that can be resolved in a telephone interview, the Examiner is urged to call Applicants' undersigned attorney.

Respectfully submitted,

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